Protecting Puget Sound Watersheds from Agricultural Pollution Using a Progressive Manure Application Risk Management (ARM) System

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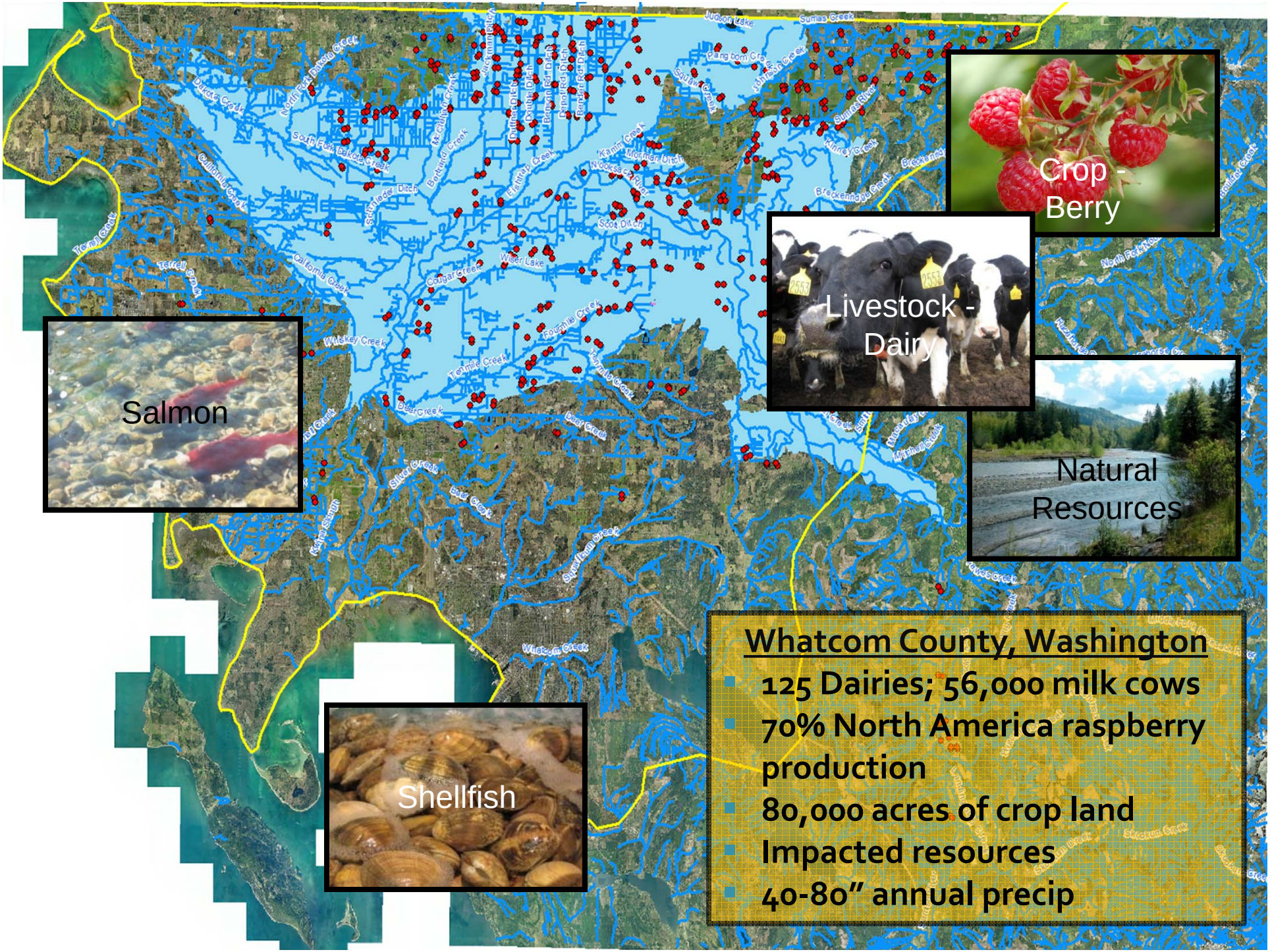
Whatcom Conservation District

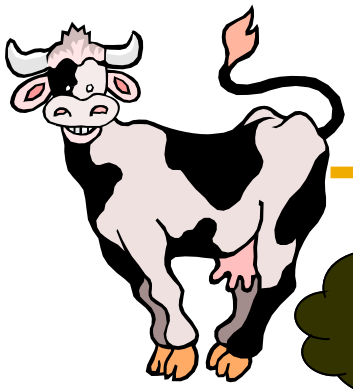
Puget Sound Meeting - EPA
Seattle, WA
May 16, 2013

Outline

- What is the Issue?
- Application Risk Management (ARM)
  - Project Overview
  - Results – WCD and USGS
- Other Application Tools and Guidance
- Discussion and Questions


Crop - Berry
Livestock - Dairy
Natural Resources
Salmon
Shellfish
Whatcom County, Washington
125 Dairies; 56,000 milk cows
70% North America raspberry production
80,000 acres of crop land
Impacted resources
40-80" annual precip

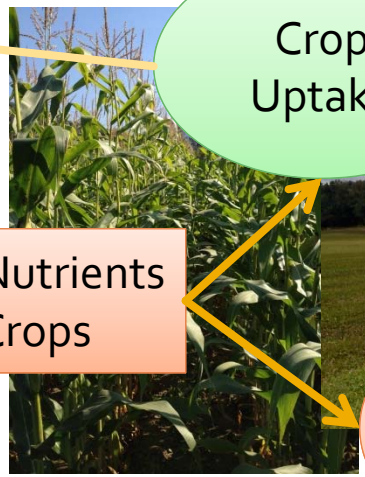
What is the Issue?



Manure Nutrient

Nutrients in grain, forage

Crop Uptake



Apply Nutrients to Crops

Excess Nutrients, Sediment, Pathogens

Manure Nutrient Balance: **1N:1.5P**

Minimize Losses!

Soil

Air

Surface Water

Ground Water

Factors That Lead to Pollution Event

- **Pollutant availability**
  - Variable uptake and/or conversion (N, P, FC,…)
- **Improper manure application/grazing practices**
  - Timing, method, rates
- **Weather events**
  - Precipitation, flooding, high water table, wind
- **Poor field conditions**
  - Soil type, slope, surface cover, saturated soils

New Guidance and Application Tools

- Application Risk Management System
- Real-time Manure Spreading Advisory
- Dynamic Manure Application Setbacks
- Guidance and educational support

Protecting Puget Sound Watersheds from Agricultural Runoff Using a Progressive Manure Application Risk Management (ARM) System

- EPA PS Watershed grant: 2010-2014
- Four Overlapping Phases:
  - Phase 1 - Assessment
  - Phase 2 - Development
  - Phase 3 - Implementation and Monitoring
  - Phase 4 - Evaluation, Adaptation, and Outreach

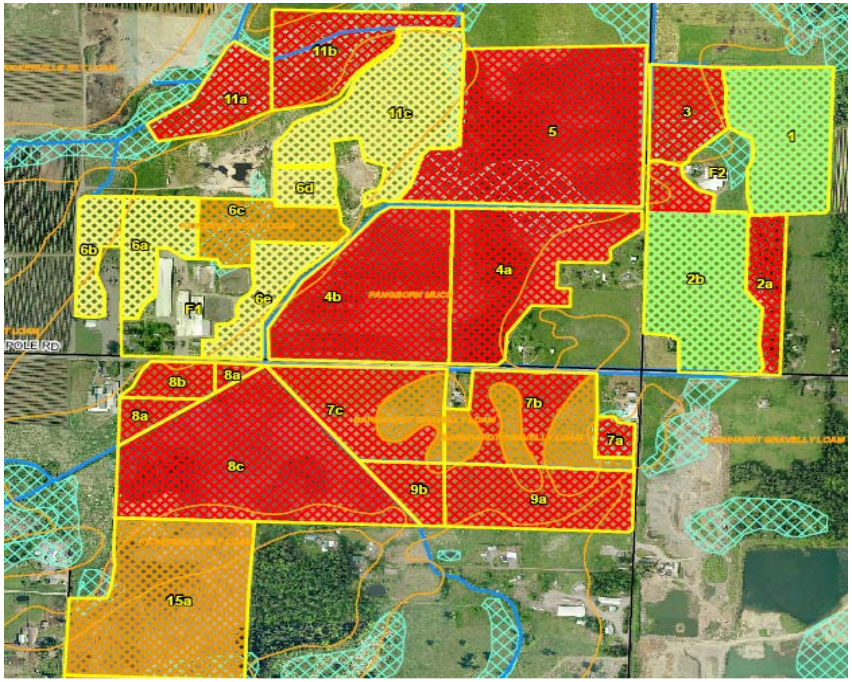
USGS science for a changing world

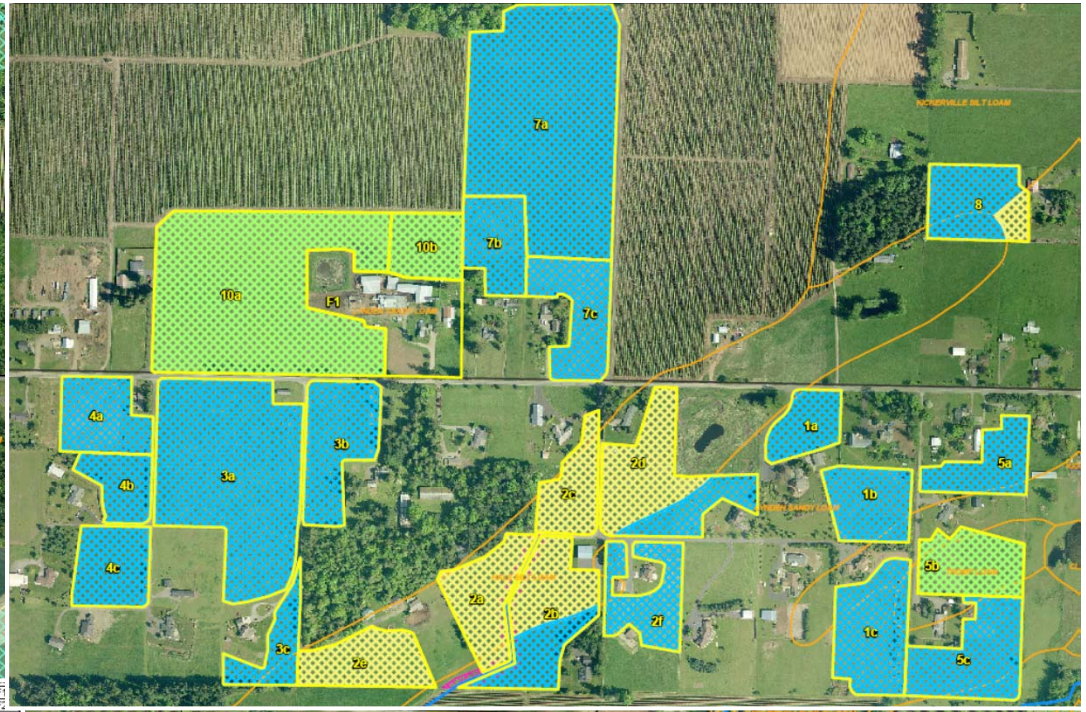
Application Risk Management (ARM)

- *System to address surface runoff, groundwater leaching, and air emissions in one tool*
- Minimize pollution risk from manure application with effective management tools and education
- Address risk on a **spatial** and **temporal** scale
- **Accountability** – Take responsibility for actions
- **Flexibility** – Better options when to apply
- Assist with application during high risk times
- ***Integrate ARM into nutrient planning process***

Field Risk Assessment & Map

- Individual field level risk assessment for runoff and leaching
- Soil risk rating based on 15+ factors and visual field assessment
- Example Risk Levels - Runoff:
  - **High** – Bare ground, adjacent water, high water table, flooding
  - **Med-High** – Minimal cover, high water table, ponding
  - **Medium** – Adjacent water, ponding, good infiltration, low slope
  - **Low-Med** – Dense cover, low water table, minimal slope
  - **Low** – Grass, no adjacent water, good infiltration, good AWC


11b
11a
11c
5
3
1
F2
6d
6c
6b
6a
F1
6e
4b
4a
2b
2a
8b
8a
8a
7c
7b
7a
8c
9b
9a
15a
POLE RD


7a
10b
10a
F1
7b
7c
8
4a
3b
3a
4b
4c
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2f
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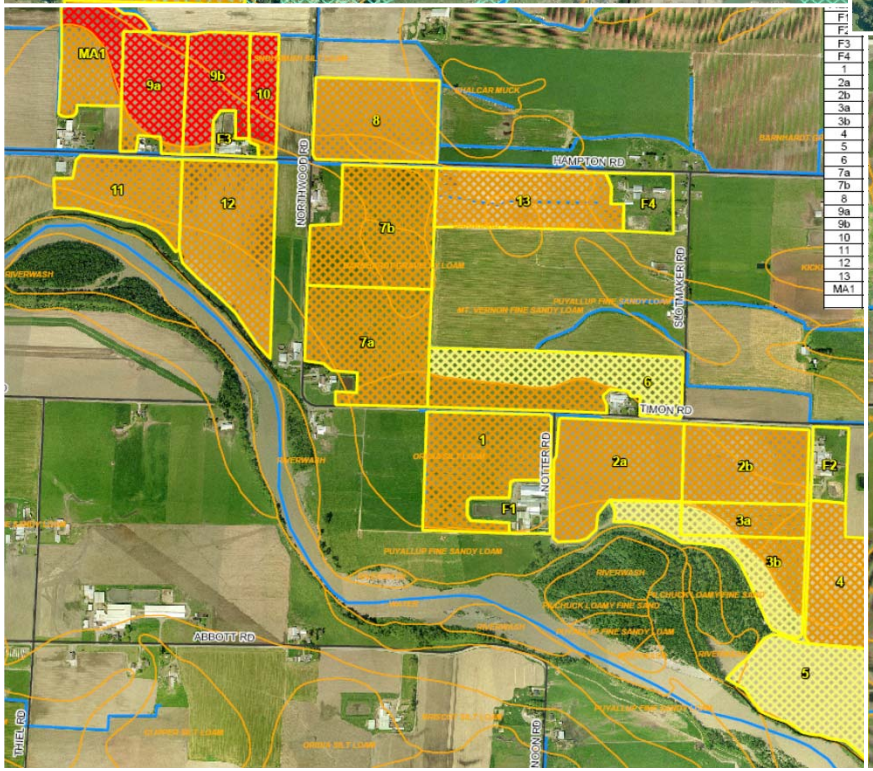
6b
1c
5c


MA1
9a
9b
10
F5
8
11
12
7b
13
F4
7a
6
1
F1
2a
2b
F2
3a
3b
4
5
HAMPTON RD
NORTHWOOD RD
SCOTTAWER RD
TIMON RD
NOTTER RD
ABBOTT RD
THIEL RD
F1
F2
F3
F4
1
2a
2b
3a
3b
4
5
6
7a
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8
9a
9b
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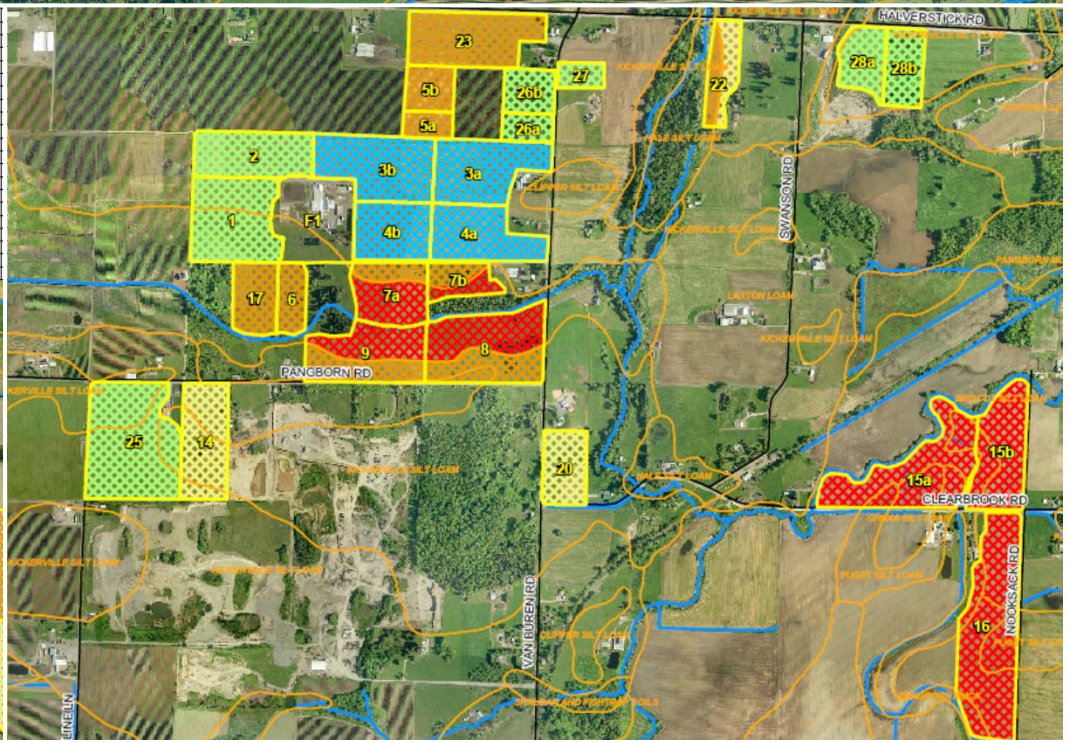
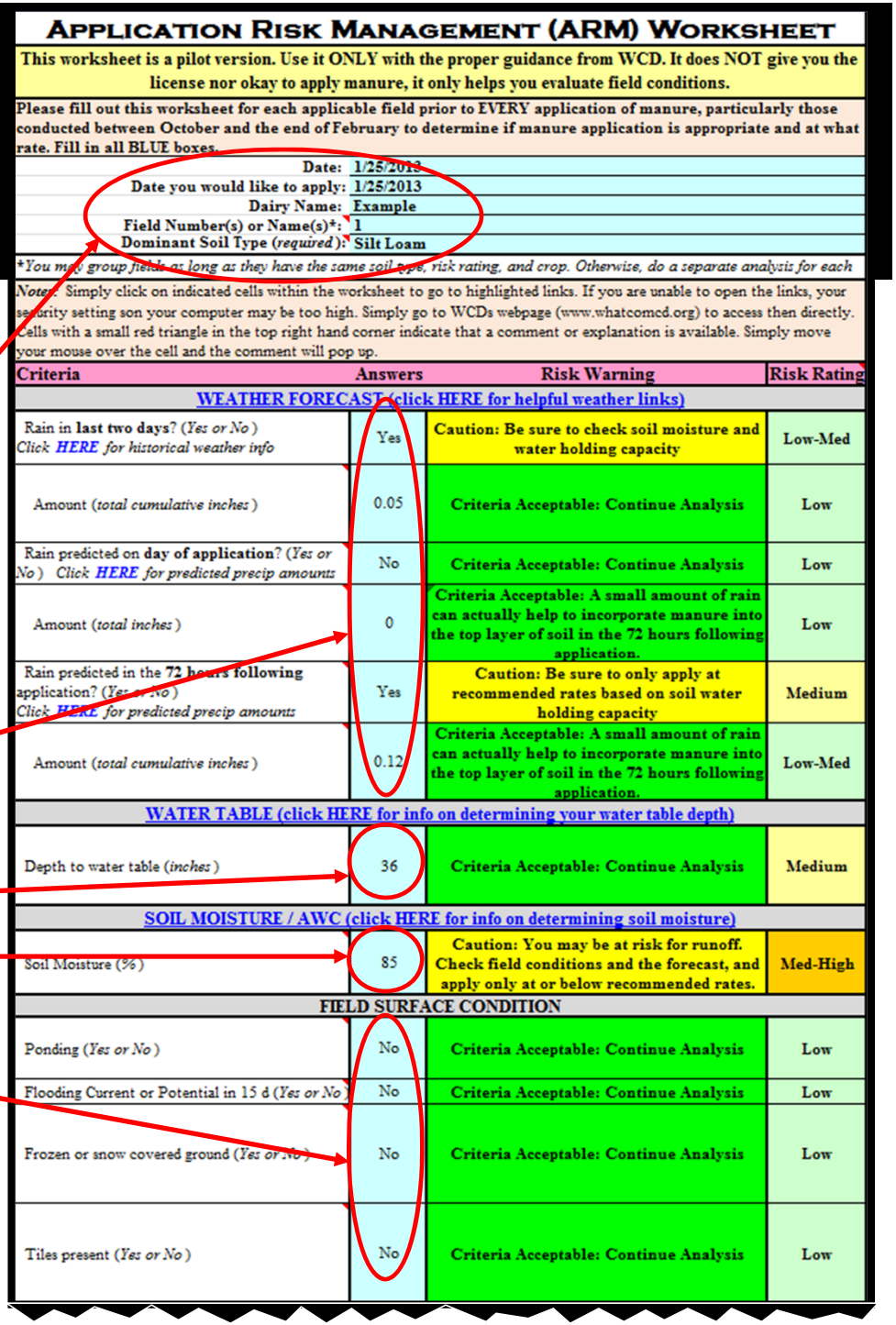
11
12
13
MA1


HALVERSTICK RD
23
5b
5a
26b
26a
27
22
28a
28b
2
3b
3a
1
F1
4b
4a
17
6
7a
7b
9
8
PANGBORN RD
SWANSON RD
25
14
20
15b
15a
CLEARBROOK RD
16
NOOKSACK RD
VAN BUREN RD
LINCOLN

ARM Worksheet

www.WhatcomCD.org/ARM

- Gives Risk Warning and Rating & Links
- Fill out Criteria
  - Information
  - Look at forecast
  - Water table depth
  - Soil Moisture
  - Assess individual field condition
  - *Continued….*



APPLICATION RISK MANAGEMENT (ARM) WORKSHEET

This worksheet is a pilot version. Use it ONLY with the proper guidance from WCD. It does NOT give you the license nor okay to apply manure, it only helps you evaluate field conditions.

Please fill out this worksheet for each applicable field prior to EVERY application of manure, particularly those conducted between October and the end of February to determine if manure application is appropriate and at what rate. Fill in all BLUE boxes.

Date:	1/25/2013
Date you would like to apply:	1/25/2013
Dairy Name:	Example
Field Number(s) or Name(s)*:	1
Dominant Soil Type (*required*):	Silt Loam

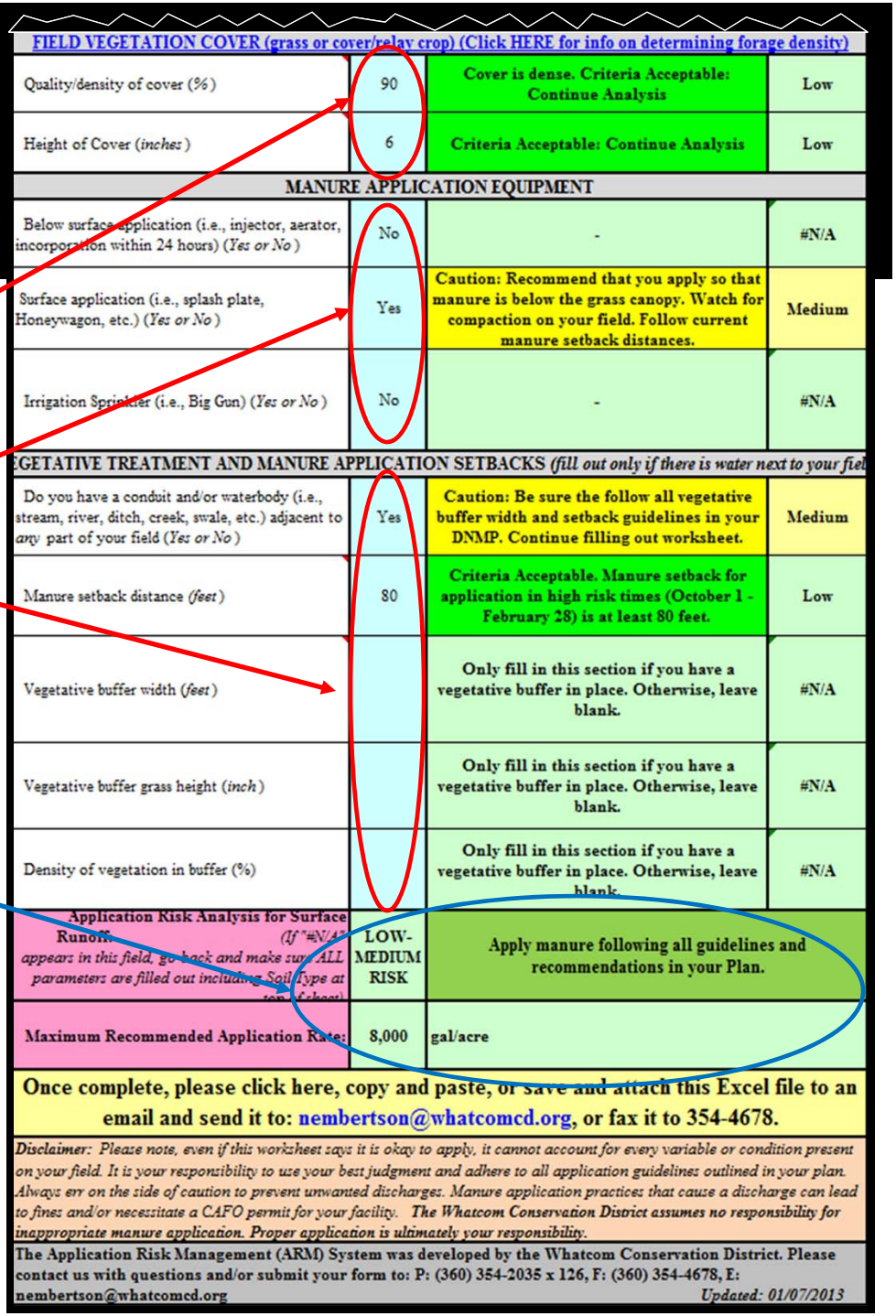
**You may group fields as long as they have the same soil type, risk rating, and crop. Otherwise, do a separate analysis for each*

Notes: Simply click on indicated cells within the worksheet to go to highlighted links. If you are unable to open the links, your security setting son your computer may be too high. Simply go to WCDs webpage (www.whatcomcd.org) to access then directly. Cells with a small red triangle in the top right hand corner indicate that a comment or explanation is available. Simply move your mouse over the cell and the comment will pop up.

Criteria	Answers	Risk Warning	Risk Rating
WEATHER FORECAST (click HERE for helpful weather links)			
Rain in **last two days**? (*Yes or No*) *Click HERE for historical weather info*	Yes	**Caution: Be sure to check soil moisture and water holding capacity**	Low-Med
Amount (*total cumulative inches*)	0.05	**Criteria Acceptable: Continue Analysis**	Low
Rain predicted on **day of application**? (*Yes or No*) *Click HERE for predicted precip amounts*	No	**Criteria Acceptable: Continue Analysis**	Low
Amount (*total inches*)	0	**Criteria Acceptable: A small amount of rain can actually help to incorporate manure into the top layer of soil in the 72 hours following application.**	Low
Rain predicted in the **72 hours following** application? (*Yes or No*) *Click HERE for predicted precip amounts*	Yes	**Caution: Be sure to only apply at recommended rates based on soil water holding capacity**	Medium
Amount (*total cumulative inches*)	0.12	**Criteria Acceptable: A small amount of rain can actually help to incorporate manure into the top layer of soil in the 72 hours following application.**	Low-Med
WATER TABLE (click HERE for info on determining your water table depth)			
Depth to water table (*inches*)	36	**Criteria Acceptable: Continue Analysis**	Medium
SOIL MOISTURE / AWC (click HERE for info on determining soil moisture)			
Soil Moisture (%)	85	**Caution: You may be at risk for runoff. Check field conditions and the forecast, and apply only at or below recommended rates.**	Med-High
FIELD SURFACE CONDITION			
Ponding (*Yes or No*)	No	**Criteria Acceptable: Continue Analysis**	Low
Flooding Current or Potential in 15 d (*Yes or No*)	No	**Criteria Acceptable: Continue Analysis**	Low
Frozen or snow covered ground (*Yes or No*)	No	**Criteria Acceptable: Continue Analysis**	Low
Tiles present (*Yes or No*)	No	**Criteria Acceptable: Continue Analysis**	Low

ARM Worksheet

- *Continued…*
  - Vegetation cover
  - Application equipment
  - Protective measures in place
- Worksheet Output
  - Overall risk
  - Max application rate
- Send to Planner
  - Check and alert producer if analysis is incorrect
- Optimizing for web and mobile



FIELD VEGETATION COVER (grass or cover/relay crop) (Click HERE for info on determining forage density)			
Quality/density of cover (%)	90	Cover is dense. Criteria Acceptable: Continue Analysis	Low
Height of Cover (*inches*)	6	Criteria Acceptable: Continue Analysis	Low
MANURE APPLICATION EQUIPMENT			
Below surface application (i.e., injector, aerator, incorporation within 24 hours) (*Yes or No*)	No	-	#N/A
Surface application (i.e., splash plate, Honeywagon, etc.) (*Yes or No*)	Yes	Caution: Recommend that you apply so that manure is below the grass canopy. Watch for compaction on your field. Follow current manure setback distances.	Medium
Irrigation Sprinkler (i.e., Big Gun) (*Yes or No*)	No	-	#N/A
EGETATIVE TREATMENT AND MANURE APPLICATION SETBACKS *(fill out only if there is water next to your fiel*			
Do you have a conduit and/or waterbody (i.e., stream, river, ditch, creek, swale, etc.) adjacent to *any* part of your field (*Yes or No*)	Yes	Caution: Be sure the follow all vegetative buffer width and setback guidelines in your DNMP. Continue filling out worksheet.	Medium
Manure setback distance (*feet*)	80	Criteria Acceptable. Manure setback for application in high risk times (October 1 - February 28) is at least 80 feet.	Low
Vegetative buffer width (*feet*)		Only fill in this section if you have a vegetative buffer in place. Otherwise, leave blank.	#N/A
Vegetative buffer grass height (*inch*)		Only fill in this section if you have a vegetative buffer in place. Otherwise, leave blank.	#N/A
Density of vegetation in buffer (%)		Only fill in this section if you have a vegetative buffer in place. Otherwise, leave blank.	#N/A
Application Risk Analysis for Surface Runoff: *(If "#N/A" appears in this field, go back and make sure ALL parameters are filled out including Soil Type at top of sheet)*	LOW-MEDIUM RISK	Apply manure following all guidelines and recommendations in your Plan.	
Maximum Recommended Application Rate:	8,000	gal/acre	

Once complete, please click here, copy and paste, or save and attach this Excel file to an email and send it to: nembertson@whatcomcd.org, or fax it to 354-4678.

Disclaimer: Please note, even if this worksheet says it is okay to apply, it cannot account for every variable or condition present on your field. It is your responsibility to use your best judgment and adhere to all application guidelines outlined in your plan. Always err on the side of caution to prevent unwanted discharges. Manure application practices that cause a discharge can lead to fines and/or necessitate a CAFO permit for your facility. The Whatcom Conservation District assumes no responsibility for inappropriate manure application. Proper application is ultimately your responsibility.

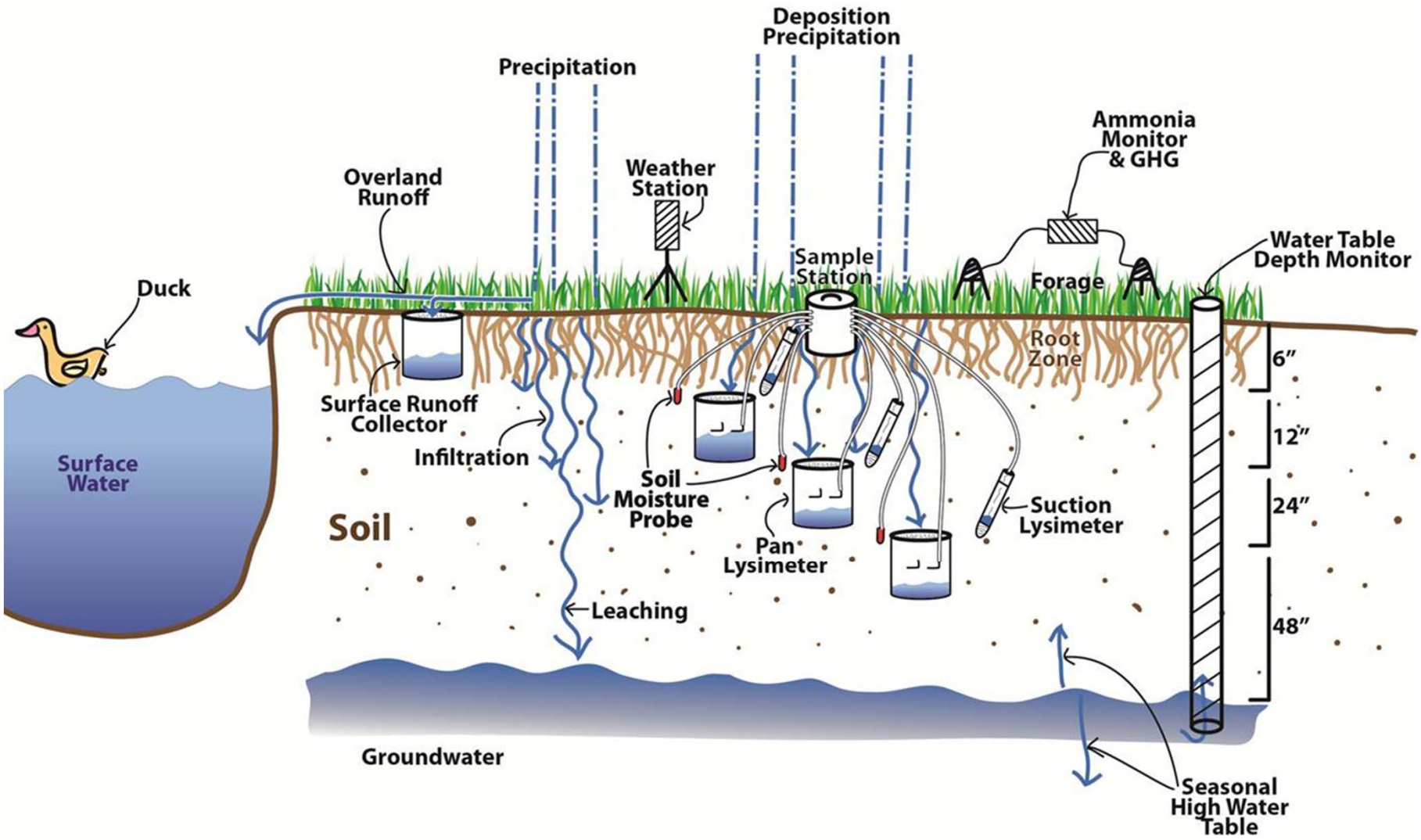
The Application Risk Management (ARM) System was developed by the Whatcom Conservation District. Please contact us with questions and/or submit your form to: P: (360) 354-2035 x 126, F: (360) 354-4678, E: nembertson@whatcomcd.org *Updated: 01/07/2013*

Assessment of ARM

- Evaluating worksheet parameters
- Field testing system and worksheet
- Monitoring, assessment, and validation
  - Soil, manure, forage, surface water, groundwater, soil water, air, meteorological

Field Testing

Field Evaluation of ARM



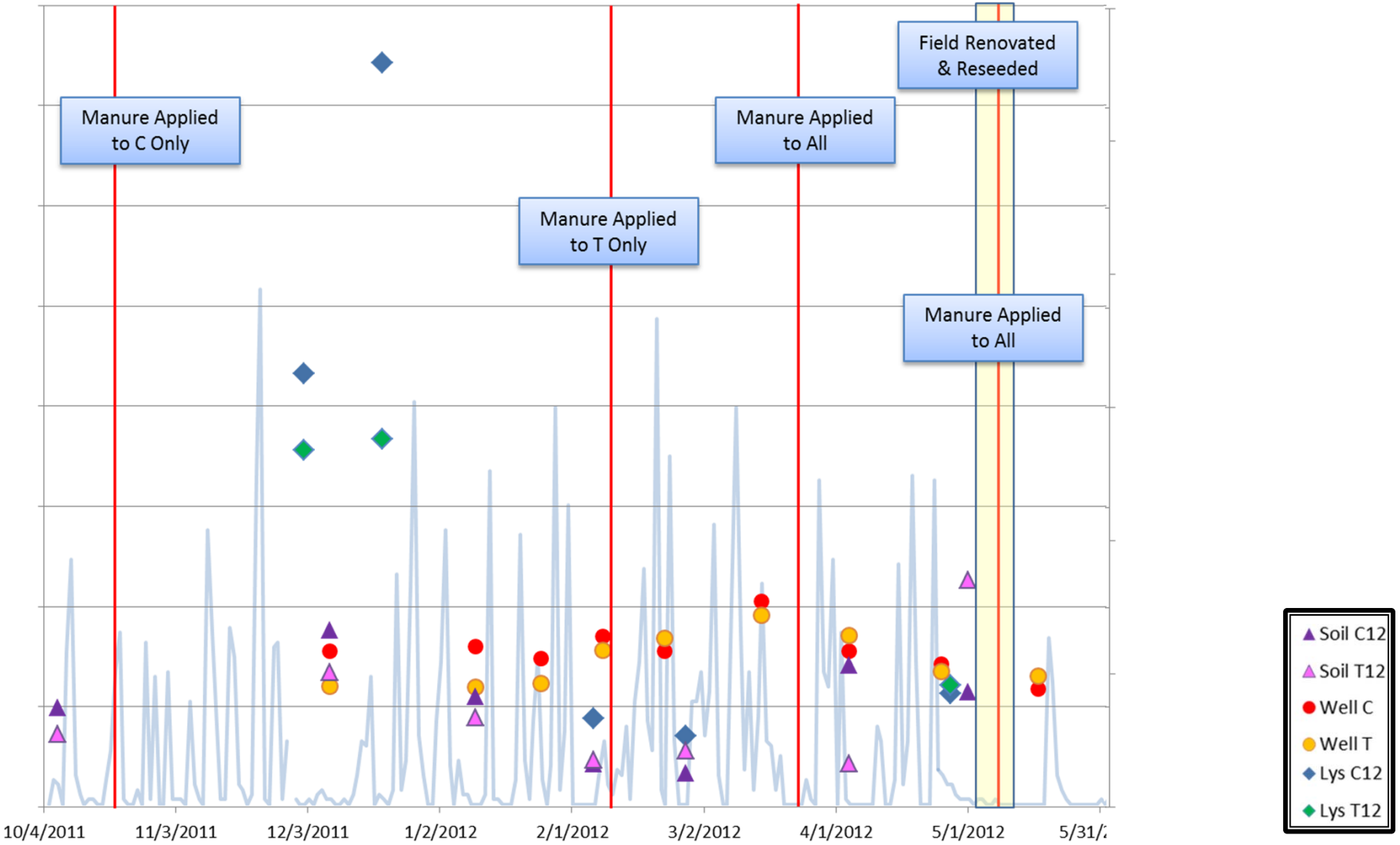
Assessment of ARM cont…

- Evaluating worksheet parameters
- Field testing system and worksheet
- Monitoring, assessment, and validation
  - Soil, manure, forage, surface water, groundwater, soil water, air, meteorological
- Adapt worksheet criteria to specific areas
- **Optimizing manure application strategies and guidance**

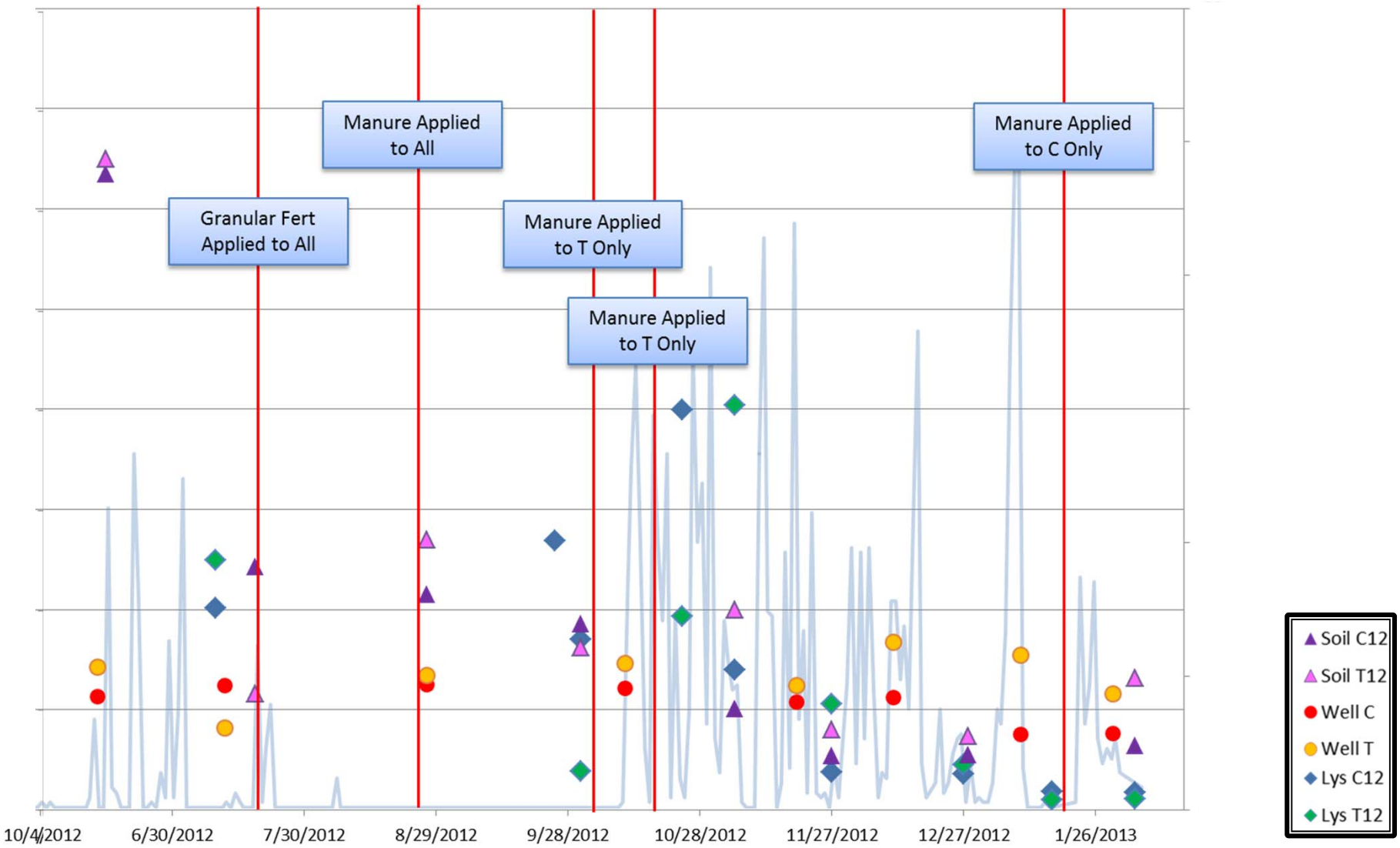
Preliminary Results

- Increased first cutting forage yield **10-40%** and density (**25%**) with early season application
- Good collaboration between soil, soil water, and groundwater results
- ARM - Limited fall application tends to reduce fall and spring nitrate leaching
- ARM – No increased leaching with early season app + reduced runoff probability

Nitrate Results – Soil and Water



Nitrate Results – Soil and Water



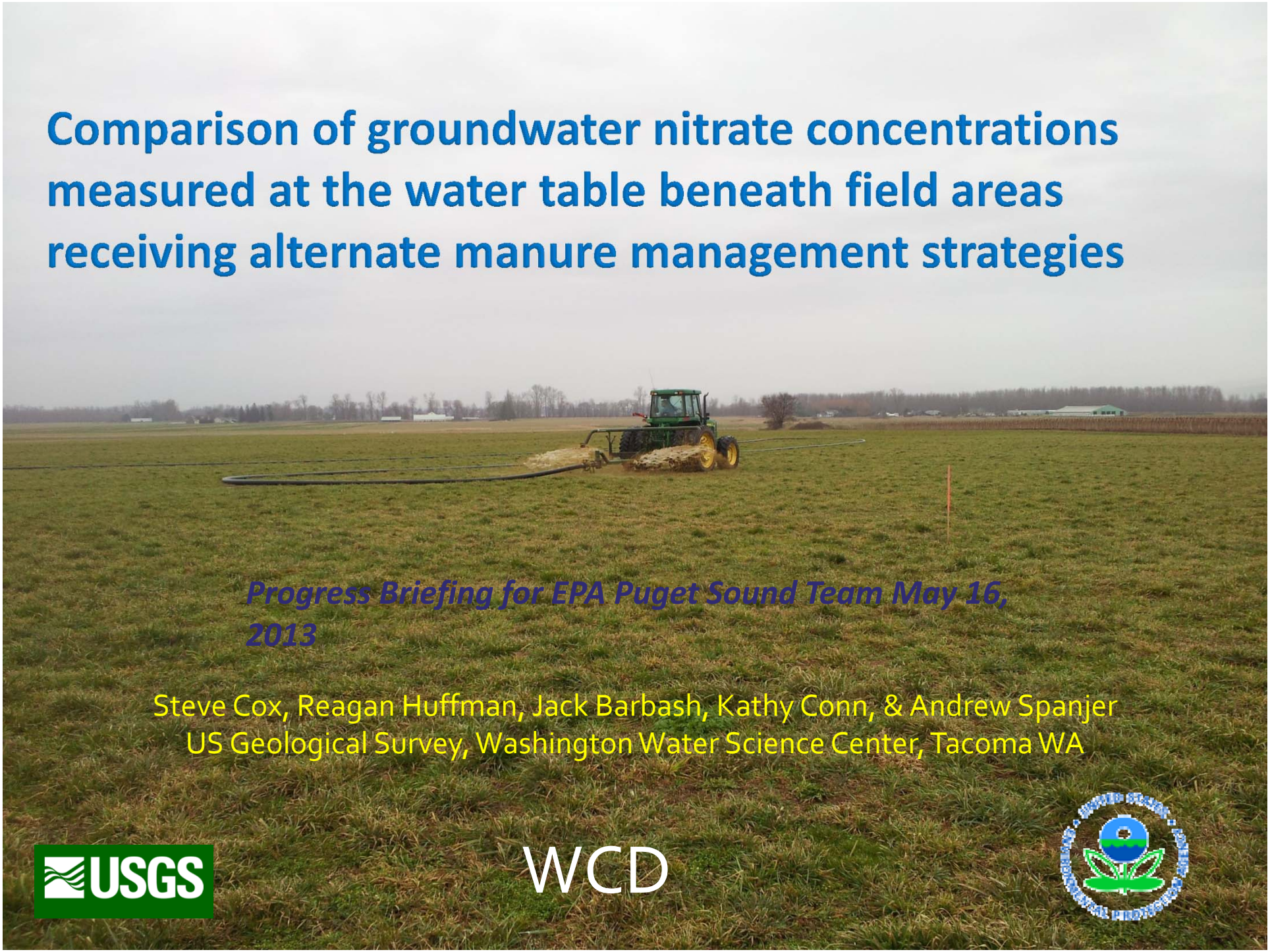
NLOS Model

- NLOS - NLEAP On Stella
  - Nitrogen Leaching and Economic Analysis Package
  - Developed by Dr's Bittman and Hunt at Agriculture and Agri-Food Canada, BC
- Model to assess and predict nitrate leaching based on things like soil type
- Working with Western Washington University

USGS Groundwater Data

Monitoring water quality at the ground water table beneath areas of dairy manure application to assess manure management strategies, Whatcom County, Washington

Comparison of groundwater nitrate concentrations measured at the water table beneath field areas receiving alternate manure management strategies



Progress Briefing for EPA Puget Sound Team May 16, 2013

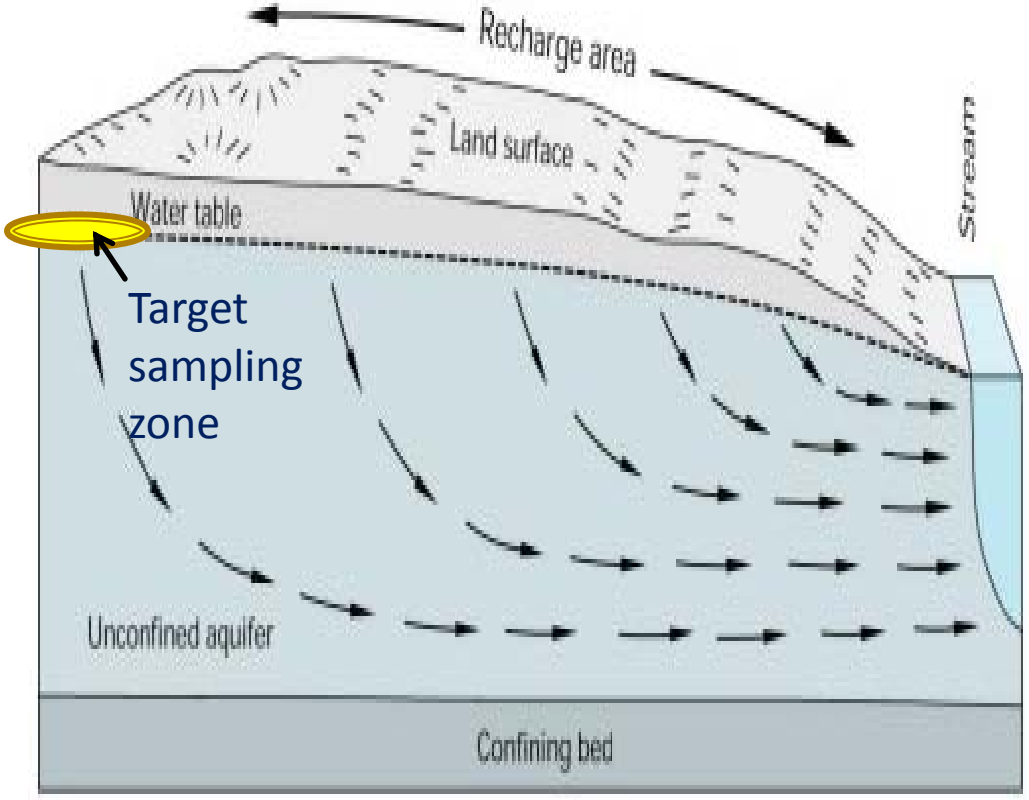
Steve Cox, Reagan Huffman, Jack Barbash, Kathy Conn, & Andrew Spanjer
US Geological Survey, Washington Water Science Center, Tacoma WA

USGS

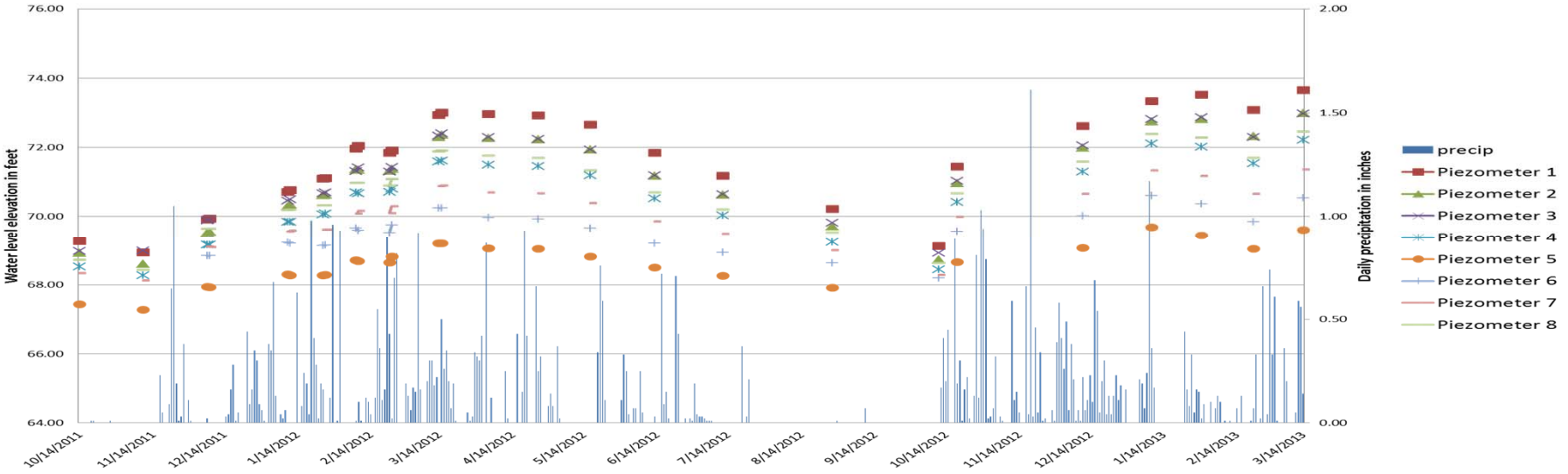
WCD

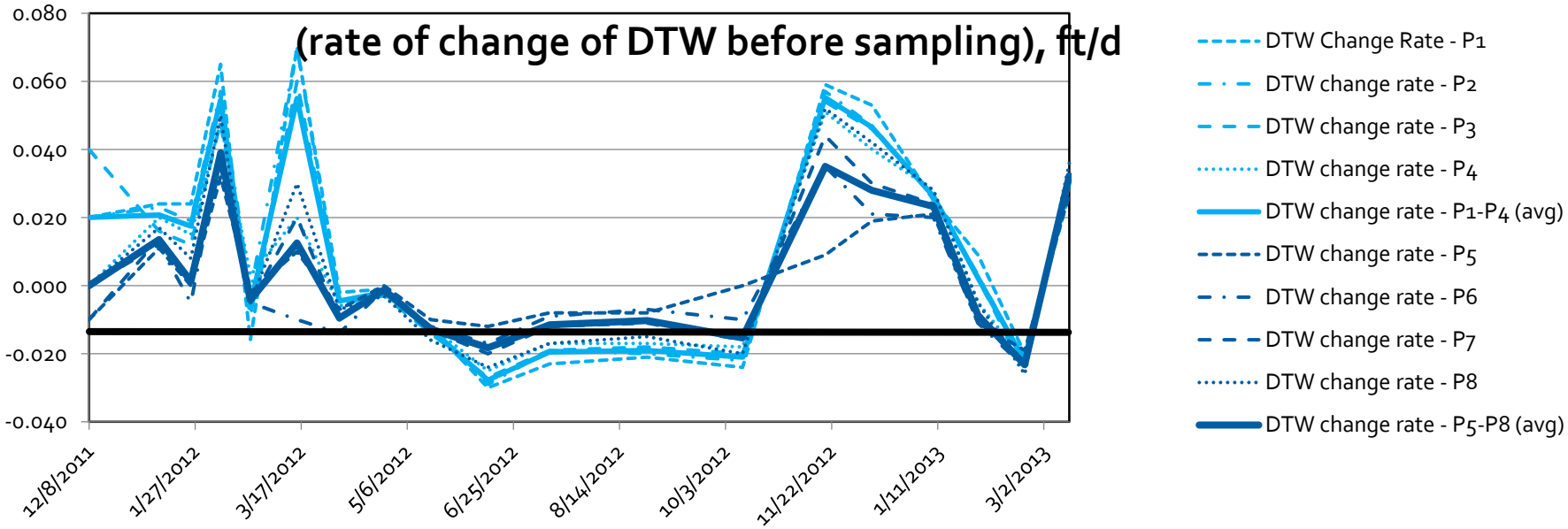
Elements considered when sampling groundwater to isolate recent recharge related to land-use activities

- Shallow depth to water
- Location of downward movement of groundwater
- Season variation of water table, 5-8 ft
- Well construction to limit flow in sand pack
- Low pumping rate limiting induced gradient



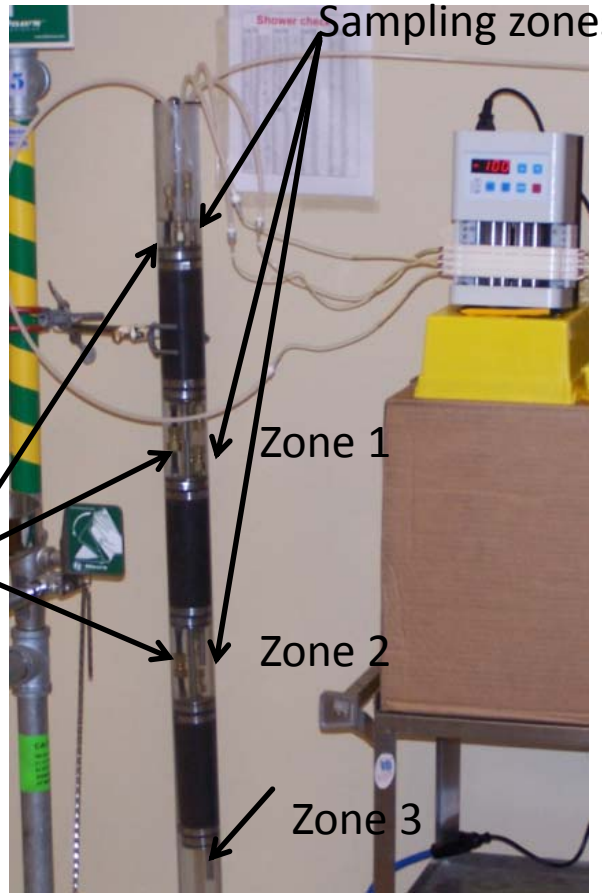
Water-levels, precipitation and recharge: D2



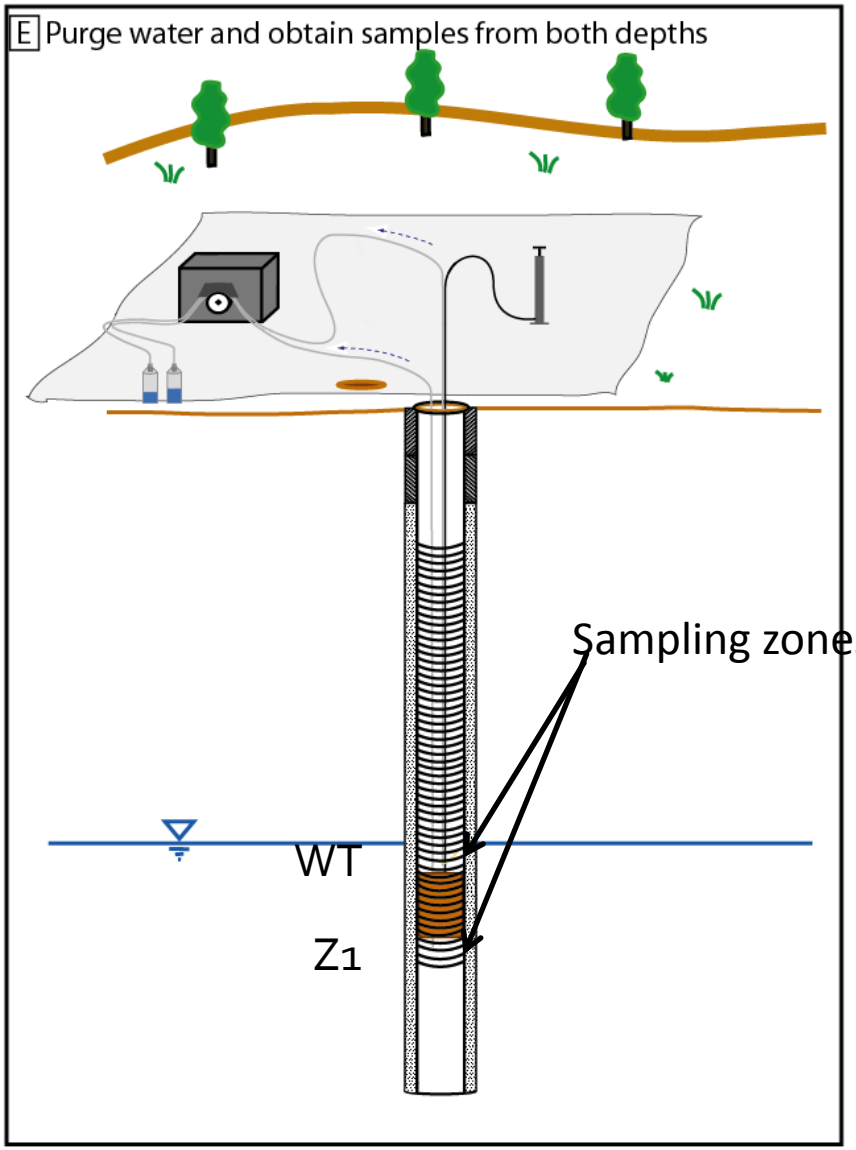


Well Sampling

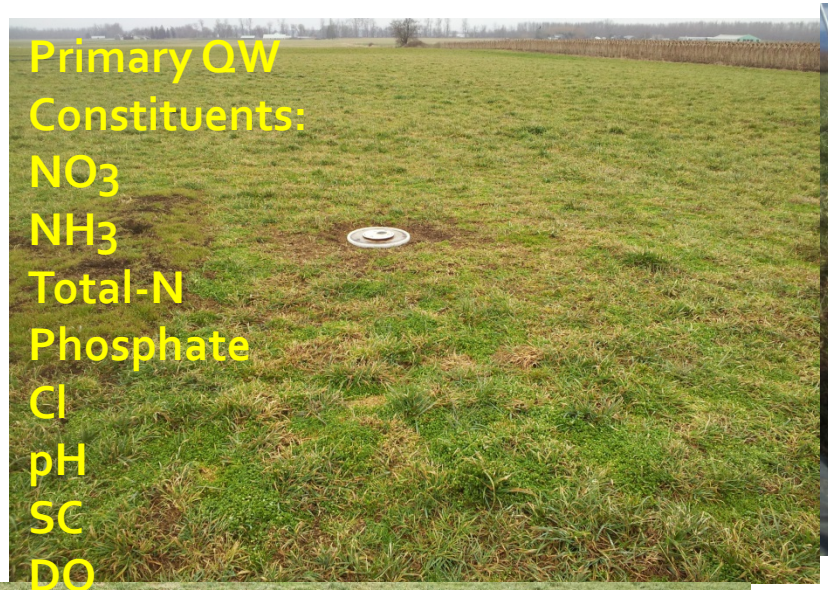
Multi-zone inflatable bladder packer sampling system



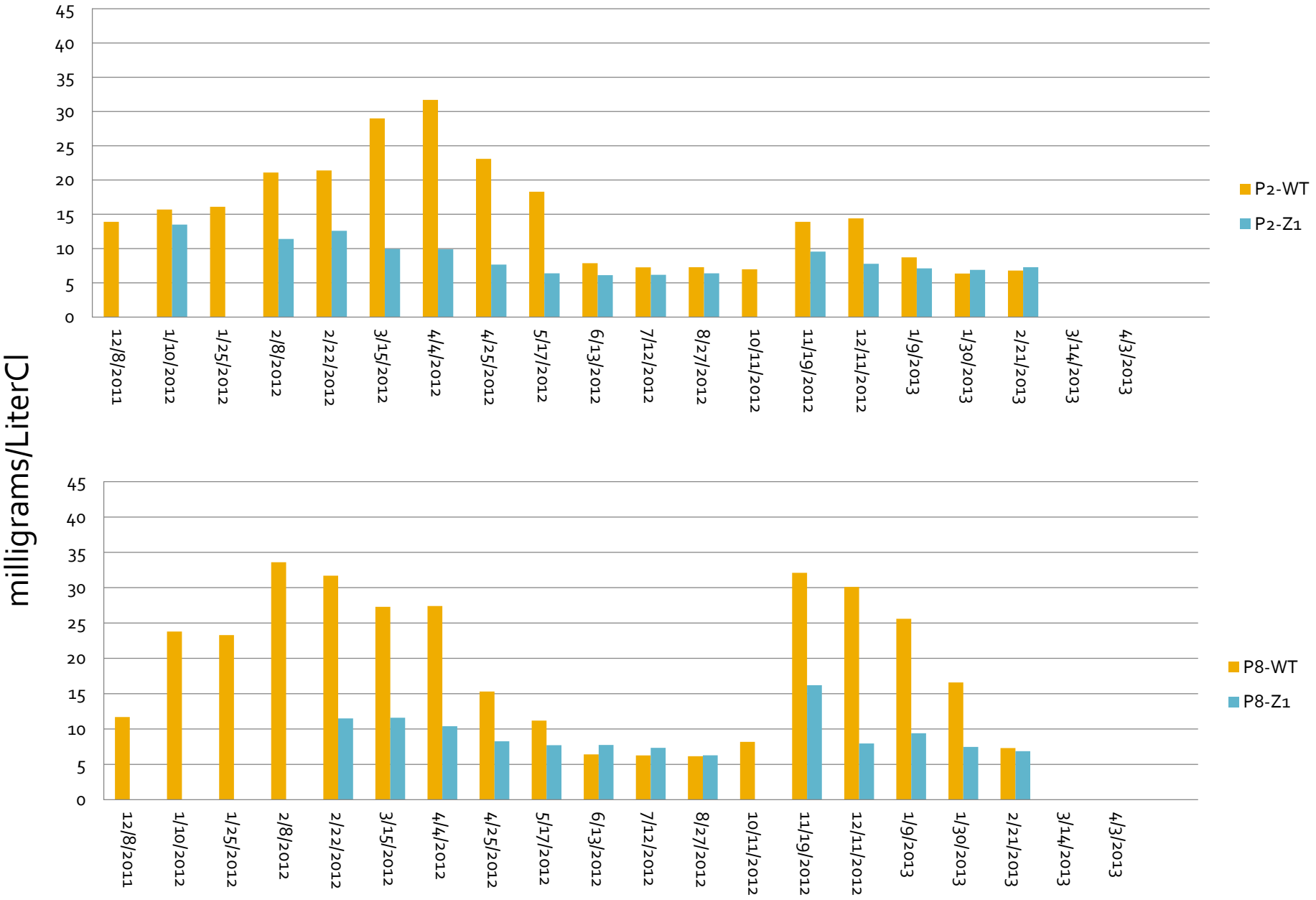
Multi-zone inflatable packer



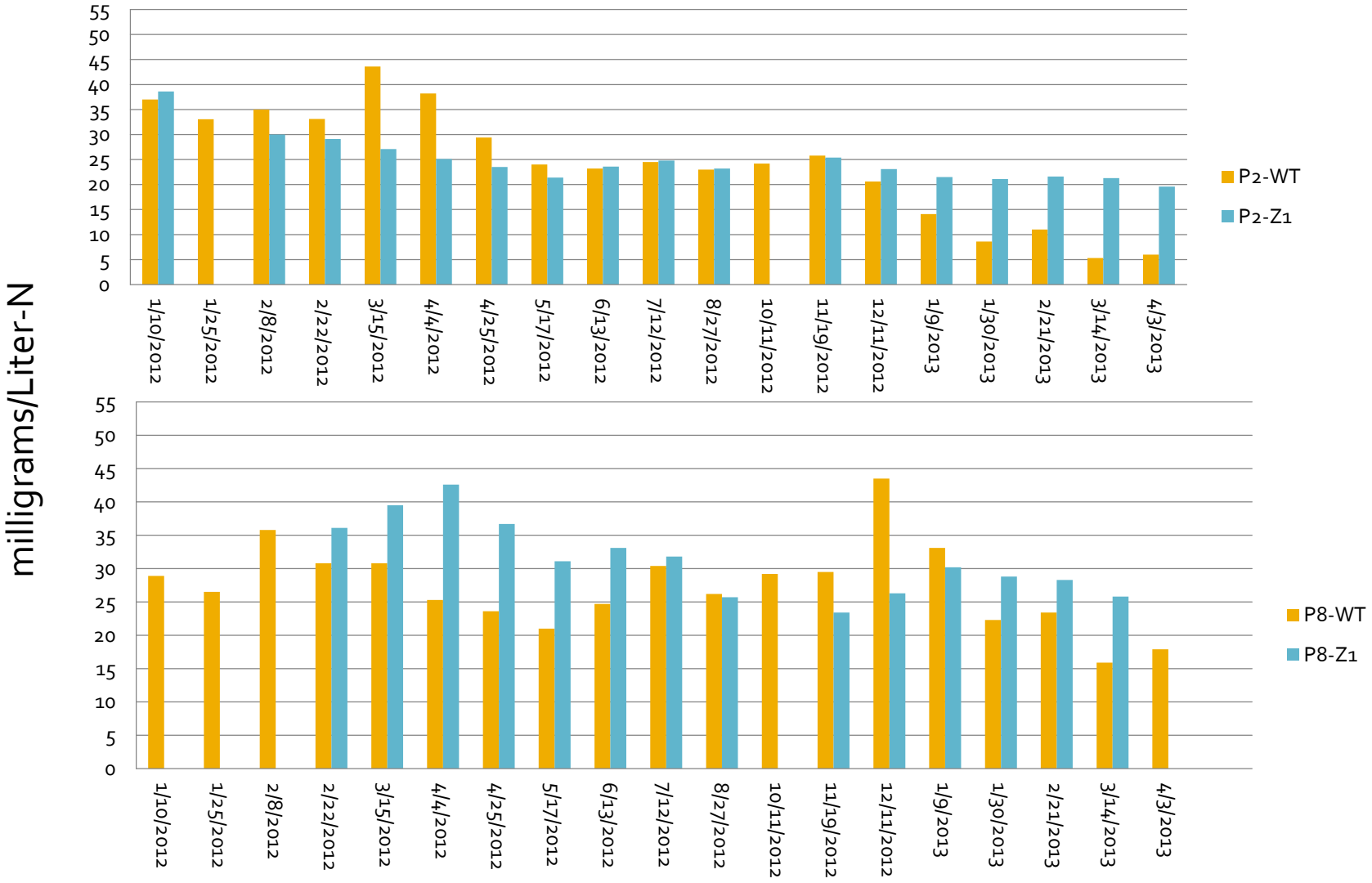
Sampling at field site D2

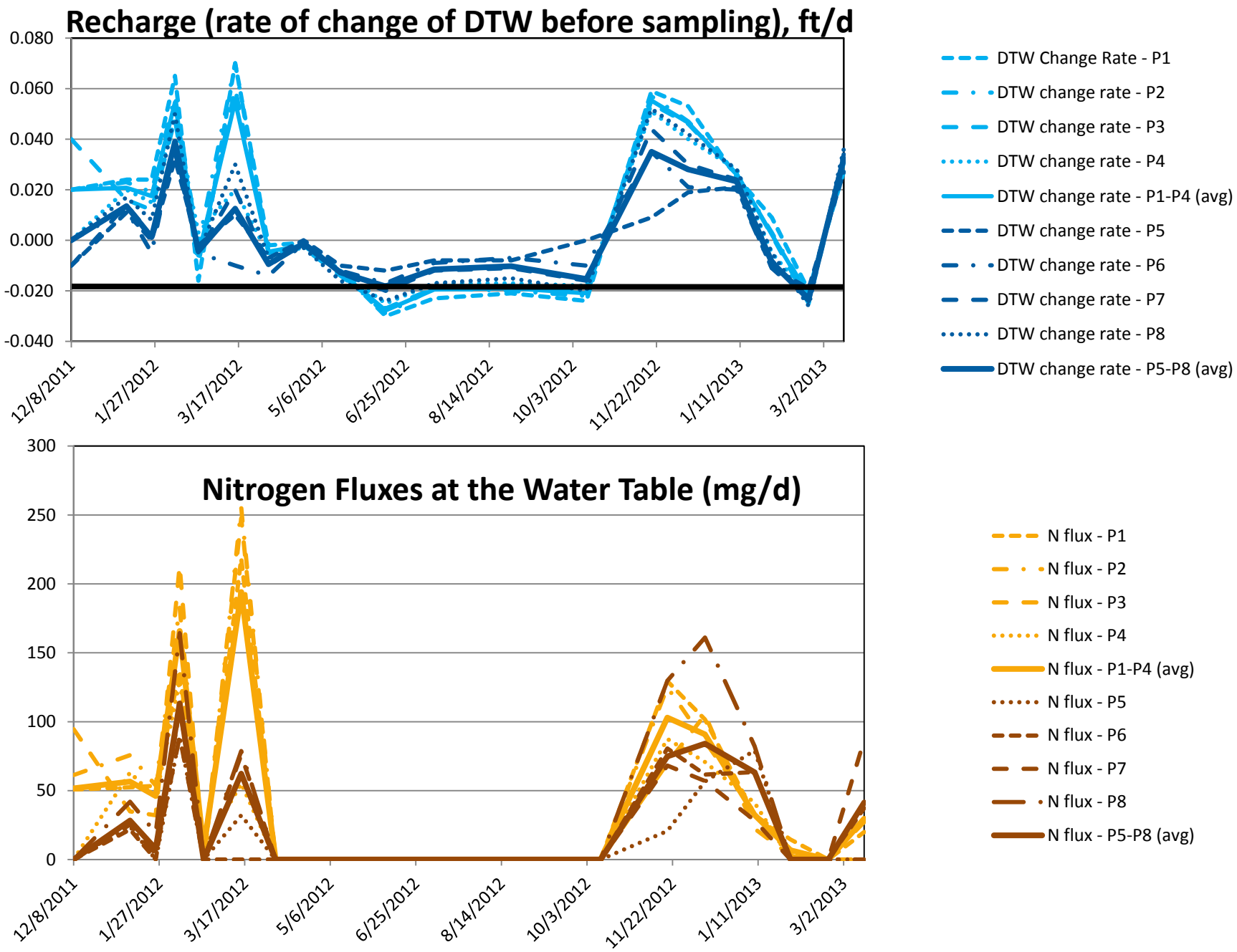


Chloride concentrations in groundwater from D2 Piezo 2



Nitrate concentration in groundwater from D2

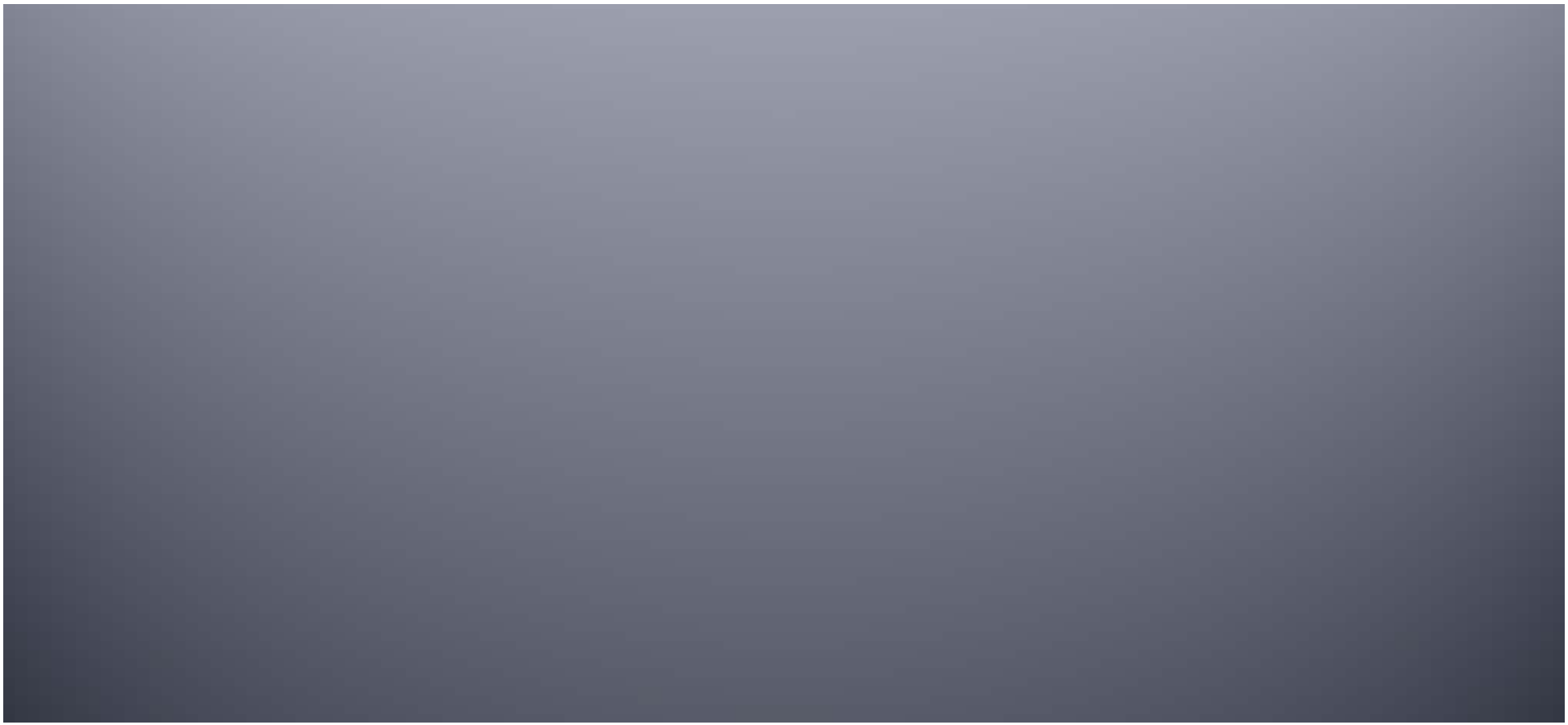



Recharge (rate of change of DTW before sampling), ft/d
0.080
0.060
0.040
0.020
0.000
-0.020
-0.040
12/8/2011
1/27/2012
3/17/2012
5/6/2012
6/25/2012
8/14/2012
10/3/2012
11/22/2012
1/11/2013
3/2/2013
DTW Change Rate - P1
DTW change rate - P2
DTW change rate - P3
DTW change rate - P4
DTW change rate - P1-P4 (avg)
DTW change rate - P5
DTW change rate - P6
DTW change rate - P7
DTW change rate - P8
DTW change rate - P5-P8 (avg)
Nitrogen Fluxes at the Water Table (mg/d)
300
250
200
150
100
50
0
12/8/2011
1/27/2012
3/17/2012
5/6/2012
6/25/2012
8/14/2012
10/3/2012
11/22/2012
1/11/2013
3/2/2013
N flux - P1
N flux - P2
N flux - P3
N flux - P4
N flux - P1-P4 (avg)
N flux - P5
N flux - P6
N flux - P7
N flux - P8
N flux - P5-P8 (avg)

Summary

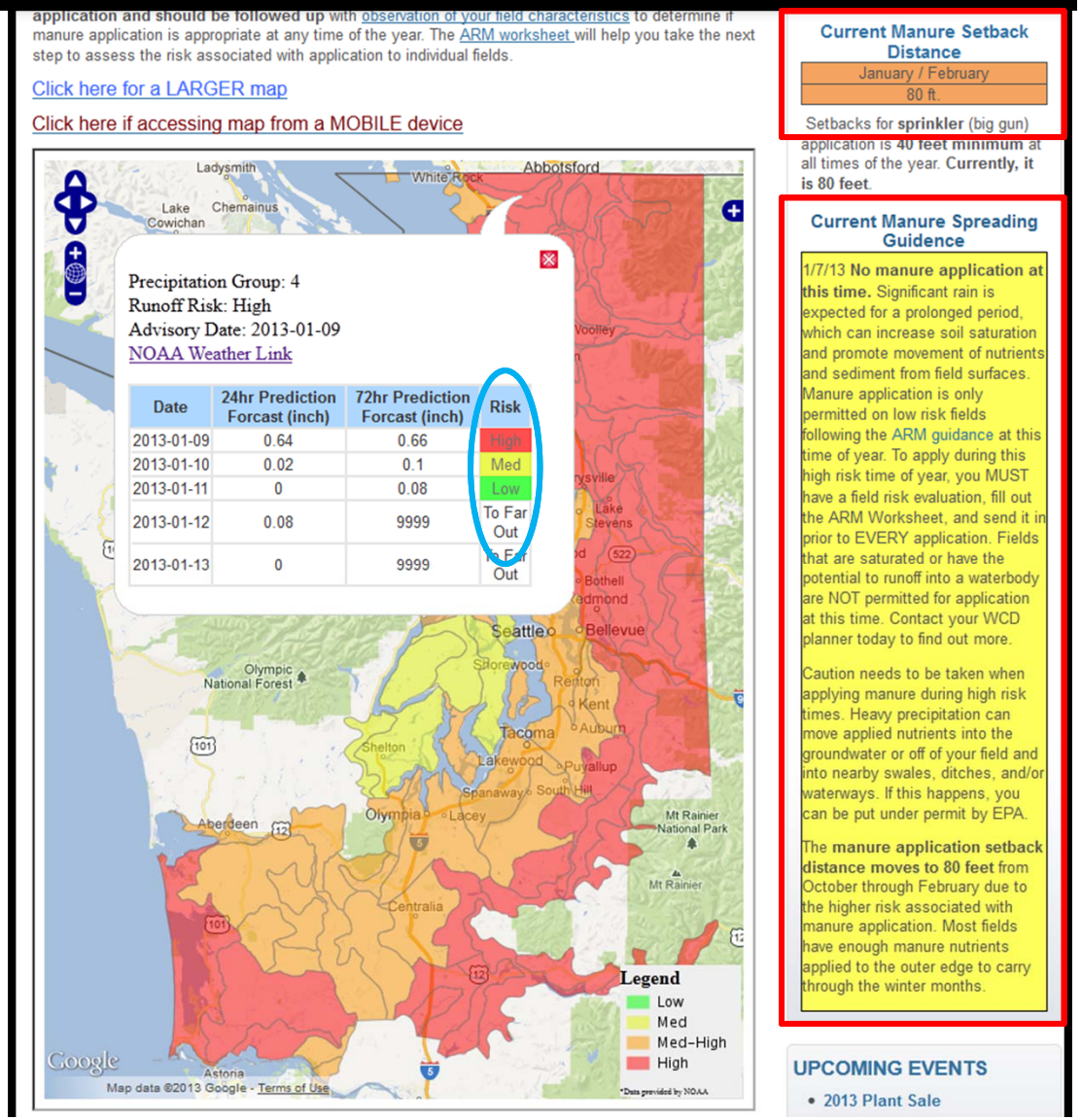
- Able to obtain QW samples from isolated water-table zone
- Preliminary analysis show differences observed between WT and Z1
- Preliminary analysis show some differences observed between treatment (ARM) and control (Conventional) plots

ARM Tools and Guidance

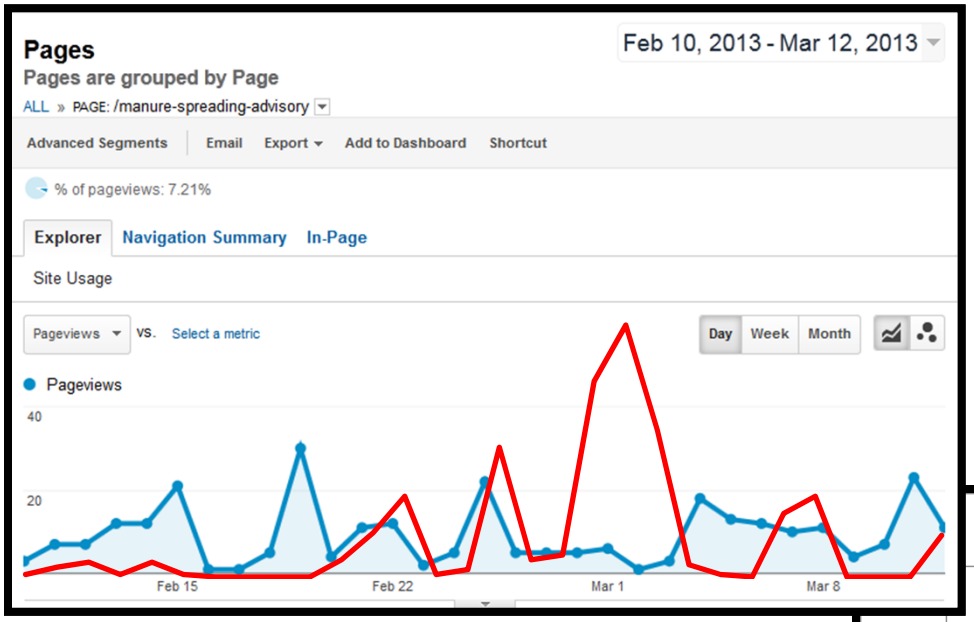


Manure Spreading Advisory

- First line of defense in runoff prevention
- "*If risk is high, don't apply*"
- Updated daily from NOAA forecast
- Current guidance and setbacks
- Optimizing for mobile use

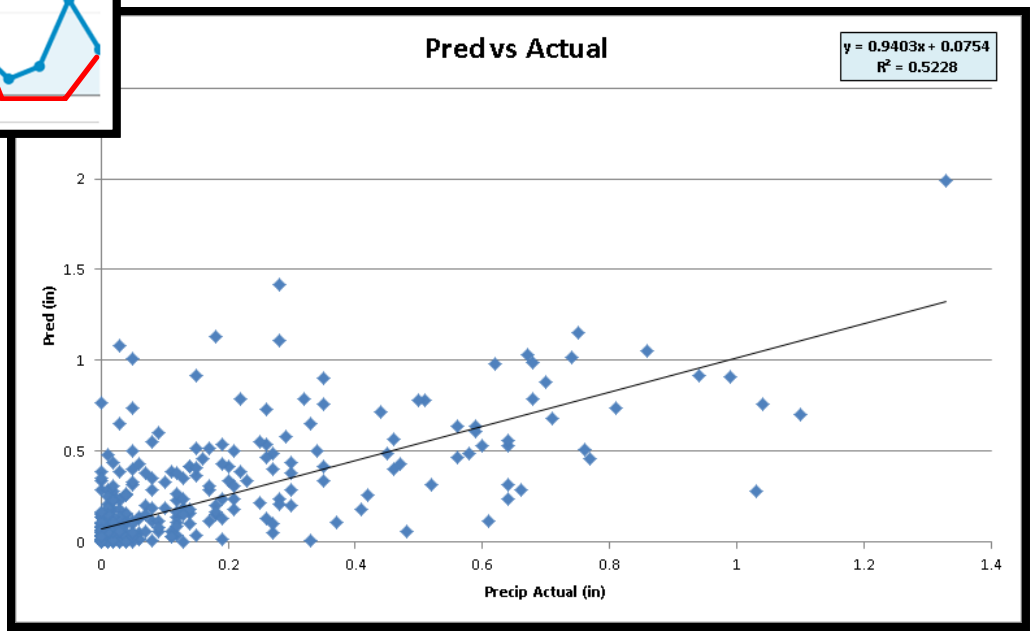


Do People Use the MSA? Yes!



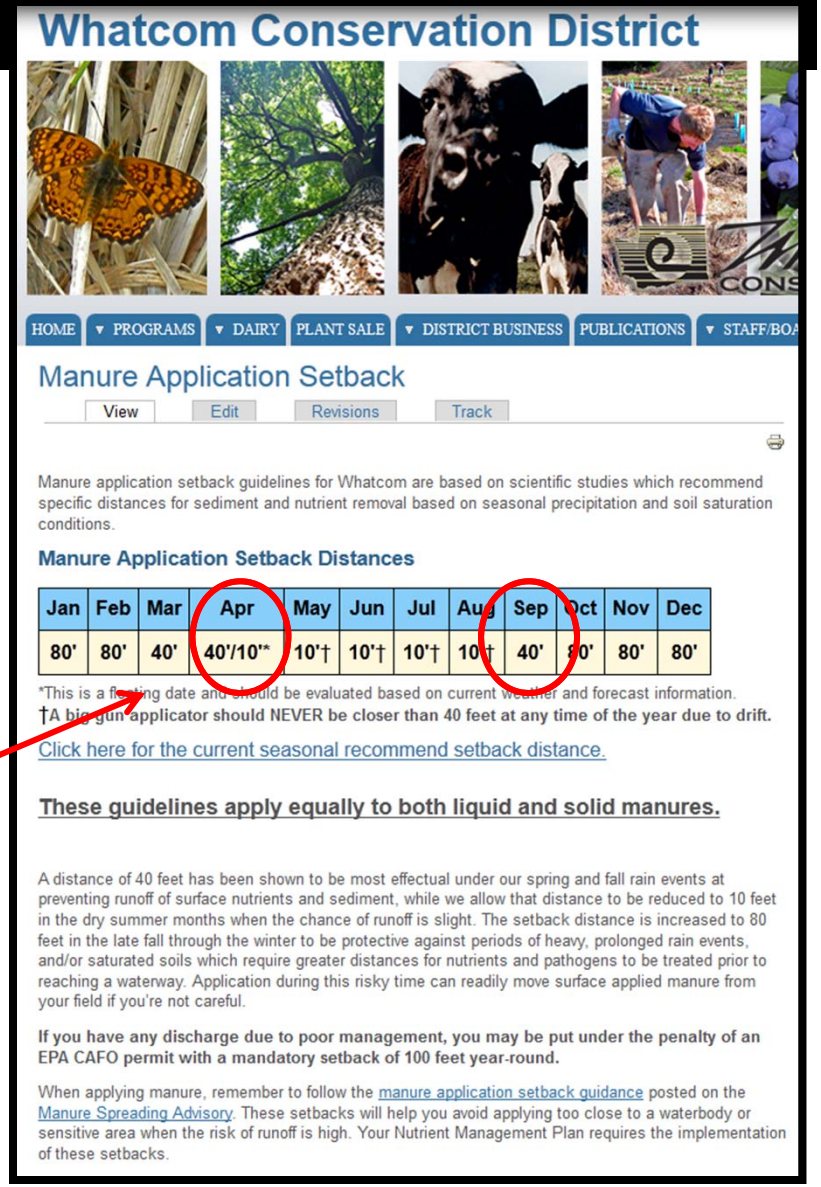
- Use correlates with precipitation patterns and farming activity

- Over 100 page views per month



Manure Application Setback Distances

- Use in lieu of filter strips where appropriate
- Based on scientific evaluation and local considerations
- Dynamic distance/date in shoulder seasons
- Apply to **both liquid and solid** manure application



Whatcom Conservation District

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Manure Application Setback

View | Edit | Revisions | Track

Manure application setback guidelines for Whatcom are based on scientific studies which recommend specific distances for sediment and nutrient removal based on seasonal precipitation and soil saturation conditions.

Manure Application Setback Distances

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
80'	80'	40'	40'/10'*	10'†	10'†	10'†	10'†	40'	80'	80'	80'

*This is a floating date and should be evaluated based on current weather and forecast information.
†A big gun applicator should NEVER be closer than 40 feet at any time of the year due to drift.

Click here for the current seasonal recommend setback distance.

These guidelines apply equally to both liquid and solid manures.

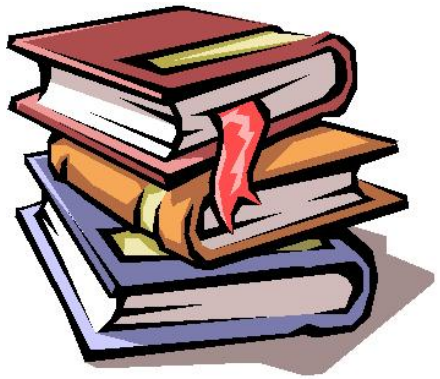
A distance of 40 feet has been shown to be most effectual under our spring and fall rain events at preventing runoff of surface nutrients and sediment, while we allow that distance to be reduced to 10 feet in the dry summer months when the chance of runoff is slight. The setback distance is increased to 80 feet in the late fall through the winter to be protective against periods of heavy, prolonged rain events, and/or saturated soils which require greater distances for nutrients and pathogens to be treated prior to reaching a waterway. Application during this risky time can readily move surface applied manure from your field if you're not careful.

If you have any discharge due to poor management, you may be put under the penalty of an EPA CAFO permit with a mandatory setback of 100 feet year-round.

When applying manure, remember to follow the manure application setback guidance posted on the Manure Spreading Advisory. These setbacks will help you avoid applying too close to a waterbody or sensitive area when the risk of runoff is high. Your Nutrient Management Plan requires the implementation of these setbacks.

Education / Information

- Keep producers connected and up-to-date
- Present current news and topics at local dairy/livestock meetings
- Monthly newsletter
- Webpage
- Targeted mailings – hot topics
- Innovative decision tools



- Create learning pathway to empower producers to make good, informed decisions

Dairy Speaker Series

- **Whatcom Dairy Speaker Series**
  - Third Thursday of every month
- Bring science and industry experts to dairy farmers
- Variety of topics
- ***Giving people the knowledge to make better decisions on their own***

Whatcom Conservation District

Washington State University Extension

WA State Dairy Federation

Next Steps

- Add 2 more farms/fields by June
- Add surface water monitoring
- Continue assessing data
- Adapting tools and guidance
- Challenges facing project….




Questions?

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